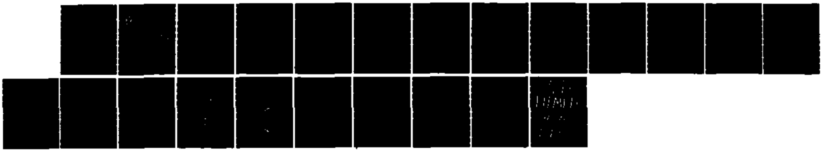
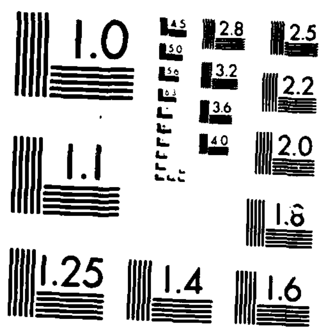
AD-A165 462 DATA TRANSMISSION NETWORK TELEMETRY MONITORING AND CONTROL(U) DEFENSE COMMUNICATIONS ENGINEERING CENTER RESTON VA T L MCCRICKARD III ET AL. FEB 85 1/1

UNCLASSIFIED DCEC-TN-2-85 F/G 17/2 NL





MICROCOPY RESOLUTION TEST CHART
NA[illegible] STANDARDS 196[illegible] A

AD-A165 462

(2)

TN 2-85

DEFENSE COMMUNICATIONS ENGINEERING CENTER

TECHNICAL NOTE NO. 2-85

DATA TRANSMISSION NETWORK TELEMETRY, MONITORING, AND CONTROL

FEBRUARY 1985

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

ADA 165462

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: Unclassified

1b. RESTRICTIVE MARKINGS:

2a. SECURITY CLASSIFICATION AUTHORITY: N/A

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE: N/A

3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; distribution unlimited.

4. PERFORMING ORGANIZATION REPORT NUMBER(S):

5. MONITORING ORGANIZATION REPORT NUMBER(S):

6a. NAME OF PERFORMING ORGANIZATION: Defense Communications Engineering Center,

6b. OFFICE SYMBOL *(If applicable)*: R220

7a. NAME OF MONITORING ORGANIZATION: N/A

6c. ADDRESS *(City, State and ZIP Code)*: 1860 Wiehle Avenue, Reston, VA 22090

7b. ADDRESS *(City, State and ZIP Code)*:

8a. NAME OF FUNDING/SPONSORING ORGANIZATION: Defense Communications Engineering Center

8b. OFFICE SYMBOL *(If applicable)*: R220

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER:

8c. ADDRESS *(City, State and ZIP Code)*: 1860 Wiehle Avenue, Reston, VA 22090

10. SOURCE OF FUNDING NOS. N/A

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.

11. TITLE *(Include Security Classification)*: Data Transmission Network Telemetry, Monitoring, and Control (U)

12. PERSONAL AUTHOR(S): Thomas L. McCrickard, III, Matthew J. Prisutti

13a. TYPE OF REPORT: Technical Note

13b. TIME COVERED: FROM ______ TO ______

14. DATE OF REPORT *(Yr., Mo., Day)*: February 1985

15. PAGE COUNT: 21

16. SUPPLEMENTARY NOTATION: Review for relevance 5 years from submission.

17. COSATI CODES

FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*:
Monitoring; Control; Data Transmission Network; Modem; Autodin; Low-Speed Time Div Multiplexing

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

With the advent of the LSTDM in large quantities, it is necessary to provide an efficient means for monitoring and controlling them. These monitoring and control functions can then be extended to other applications within the DCS. These issues and their possible solutions are discussed.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS ☐

21. ABSTRACT SECURITY CLASSIFICATION: Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL: Thomas L. McCrickard, III

22b. TELEPHONE NUMBER *(Include Area Code)*: (703) 437-2787

22c. OFFICE SYMBOL: R220

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

SECURITY CLASSIFICATION OF THIS PAGE

TECHNICAL NOTE NO. 2-85

DATA TRANSMISSION NETWORK TELEMETRY, MONITORING, AND CONTROL

FEBRUARY 1985

Prepared By:

O Thomas L. McCrickard, III

O Matthew J. Prisutti

Approved for Publication:

D. O. SCHULTZ
Acting Deputy Director for
Transmission Engineering

FOREWORD

The Defense Communications Engineering Center (DCEC) Technical Notes (TN's) are published to inform interested members of the defense community regarding technical activities of the Center, completed and in progress. They are intended to stimulate thinking and encourage information exchange; but they do not represent an approved position or policy of DCEC, and should not be used as authoritative guidance for related planning and/or further action.

Comments or technical inquiries concerning this document are welcome, and should be directed to:

Director
Defense Communications Engineering Center
1860 Wiehle Avenue
Reston, Virginia 22090

EXECUTIVE SUMMARY

During the 1980-1990 time frame, the Defense Communications System (DCS) will continue to transition from a system based on analog transmission and switching facilities to one based on digital technology. This transition, which is driven by the need for security and the economic and operational benefits of digital processing, will be accompanied by the growth and restructuring of the digital data transmission requirements to be satisfied by the DCS. To accommodate these changes in digital data transmission requirements and to capitalize on the evolution of the DCS to digital operation, a Data Transmission Network (DTN) has been planned. The implementation of this network will generally be phased to the deployment of digital transmission facilities throughout the DCS, and will be structured to accommodate new digital data transmission requirements as well as those presently satisfied by Voice Frequency Modems and Voice Frequency Carrier Telegraph (VFCT) networks.

The cornerstone of the successful implementation of the DTN is the Low Speed Time Division Multiplexer (LSTDM), nomenclatured AN/FCC-100. The AN/FCC-100 will concentrate the mix of user data services entering the DTN into a single high speed synchronous data channel. Due in part to the versatility of the AN/FCC-100, significent numbers will be implemented worldwide. (At this writing almost 2000 units have been delivered to the military departments.)

There are a number of LSTDM applications in which the overall channel efficiency can not be fully utilized. These applications include modem interface, Autodin applications, as well as remote monitoring and control. This report describes these anomolies and discusses a means for solving them.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

I. INTRODUCTION

The AN/FCC-100(V) (Low Speed Time Division Multiplexer (LSTDM)) is a microprocessor implemented, full duplex multiplexer/demultiplexer that is designed to interface with a wide variety of user terminals. The principal applications of the AN/FCC-100 are to provide subscriber data channels for the Data Transmission Network (DTN) at the serving nodal locations and to multiplex up to sixteen of these channels into a data trunk for transmission over the available transmission facilities.

Originally envisioned to play the role of the submultiplexer in the Digital Radio and Multiplexer Acquisition (DRAMA) equipment hierarchical configuration, the AN/FCC-100 has emerged as the user focal point for entrance into the Defense Communications System (DCS). The FCC-100's versatility is depicted in Figure 1. Not only will the FCC-100 operate over various transmission media (communication satellites, line-of-sight microwave, troposcatter, leased links, and cable) within the digital DCS, but analog communications can also be accommodated in a full duplex manner via voice frequency (VF) line modems.

NOTES:

1. Separate Data Buffer not required, since it is provided in the AN/FCC-100(V).

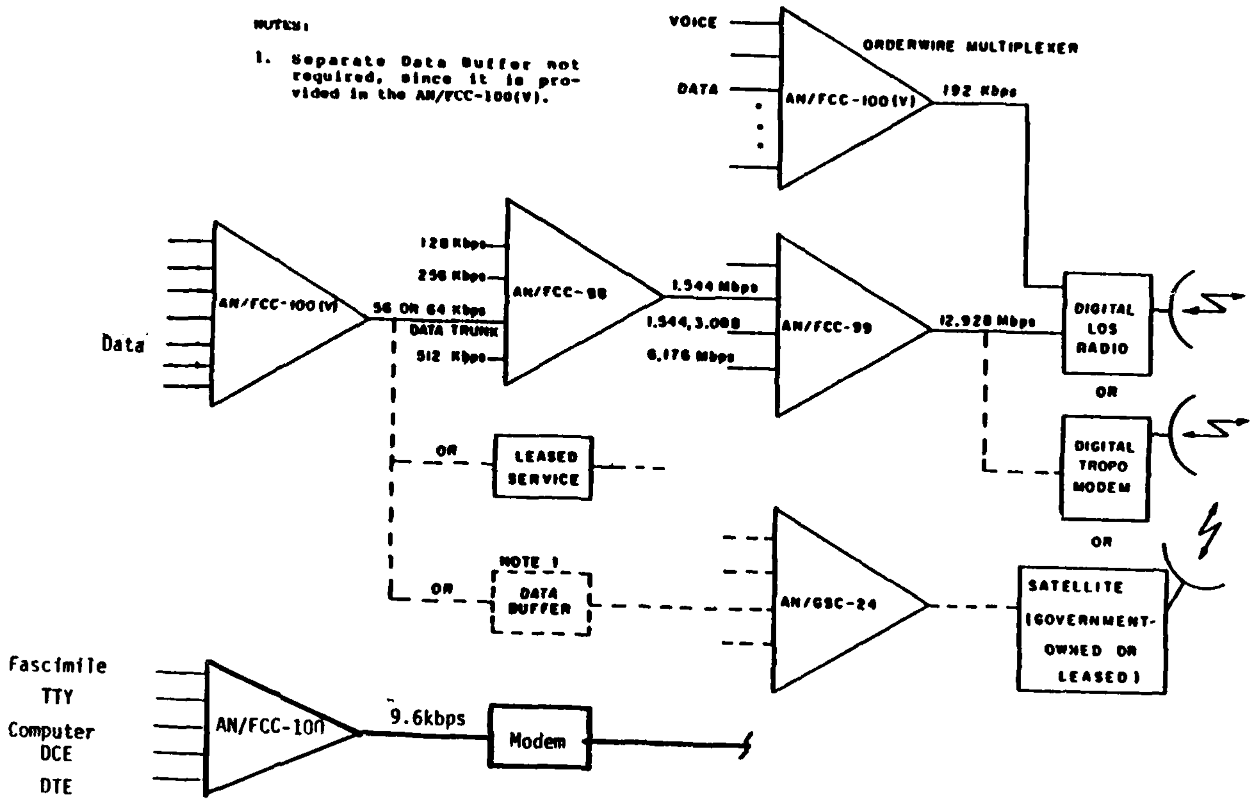


FIGURE 1
Typical AN/FCC-100 Applications

II. APPLICATION TO MODEM INTERCHANGE SIGNALS

1. DESCRIPTION

Originally the AN/FCC-100 was designed to meet the electrical characteristics of MIL-STD-188-114 for data and clock; however, many requirements exist for data terminations using RS-232-C. RS-232-C (Ref [3], although developed to satisfy interface requirements for equipment designed with older technology, is still pervasively and predominantly available in off-the-shelf commercial equipment. This condition exists, despite the publication of more recent Electronics Industries Association (EIA), federal and military standards (including MIL-STD-188-114) which were intended to replace EIA RS-232-C. Due to the desirability of acquiring off-the-shelf commercial equipment, many DOD applications have been satisfied with equipment designed per EIA RS-232-C and in order to maintain interoperability with these equipments, it is necessary for the FCC-100 to interface with equipment designed per EIA RS-232-C.

The interfaces between data terminal equipment and data communication equipment for the transfer of binary data, control, and timing signals are known as interchange circuits (Ref [4]). In any type of practical equipment, a selection will be made from the range of interchange circuits available. Four of the most commonly known interchange circuits between Data Circuit Terminating Equipment (DCE) and Data Terminal Equipment (DTE) are:

1. Request to Send (RTS): Signals on this circuit control the data channel transmit function of the data communication equipment.

2. Clear to Send (CTS): Signals on this circuit indicate whether the data communication equipment is conditioned to transmit data on the data channel.

3. Data Set Ready (DSR): Signals on this circuit indicate whether the data communication equipment is ready to operate.

4. Data Terminal Ready (DTR): Signals on this circuit control switching of the signal-conversion or similar equipment to or from the line.

The above RS-232-C interface protocols are not currently provided by the AN/FCC-100.

2. VFCT REPLACEMENT

Within the DTN initial implementation, the NAVY will be replacing their Voice Frequency Carrier Telegraph (VFCT) with AN/FCC-100's and Paradyne MP-96 Model 2496 modems. However, based on commercial literature and a technical evaluation performed by the U.S. Navy it has been discovered that the FCC-100 will not directly interface or interoperate with voice frequency modems. The handshake protocols required to directly interface VF modems were not included in the FCC-100 aggregate I/O or port interfaces.

III. APPLICATION TO AUTODIN

1. DESCRIPTION

In addition to the above interchange circuit requirement, the overseas Autodin network presently utilizes individual control circuits to perform cryptographic synchronization functions as shown in Figure 2. When for any reason a circuit is out of service, a synchronization inhibit signal is sent to the cryptographic device or the associated synchronization unit (CAU) to prevent resynchronization attempts. In its normal operation, when a cryptographic device in the Autodin network detects a loss of synchronization, it will automatically attempt to resynchronize. If after three attempts resynchronization is not achieved, the cryptographic device will alarm and require human intervention to clear the alarm and reestablish synchronization. If the circuit remains out of service, the alarms become useless after the original notification and eventually a nuisance, and no amount of human intervention will restore synchronization until the circuit is restored to operation. Therefore, to prevent resynchronization attempts by the cryptographic device, the modem carrier detect signal is used as a synchronization inhibit input to the cryptographic/CAU device. This prevents excessive human intervention in resynchronizing cryptographic devices (e.g., KG 84, KG 34, KG 13) after circuit outage occurrences. At present, overseas Autodin switches use modems to provide the primary DCE synchronization control function described above.

When the modem carrier detect is enabled, the synchronization inhibit lead is activated and the cryptographic devices will remain idle. Upon restoration of service, the modem carrier detect function is automatically removed and the cryptographic device will no longer be prohibited from resynchronization attempts. With the circuit restored, the cryptographic device resynchronization will normally occur upon the first resynchronization attempt. This procedure drastically reduces any requirement for human intervention for cryptographic resynchronization when circuit outages occur.

2. CONTROL SIGNALS WITHIN THE FCC-100

The AN/FCC-100 makes no provision for a control signal as described previously on an individual channel basis. In order to provide such a signal, the FCC-100, as presently designed, would have to dedicate individual data ports for each circuit requiring the synchronization inhibit function, as depicted in Figure 3. This would reduce the efficiency of the FCC-100 by as much as 50% (e.g., for eight data channels, the remaining eight port channels would be used for control signals). Not only would this inefficiency take place between the Autodin Switching Center (ASC) and its serving Technical Control Facility (TCF), but also throughout the DTN in order to provide this function on an end-to-end basis between ASC and the associated data terminal (Figure 3).

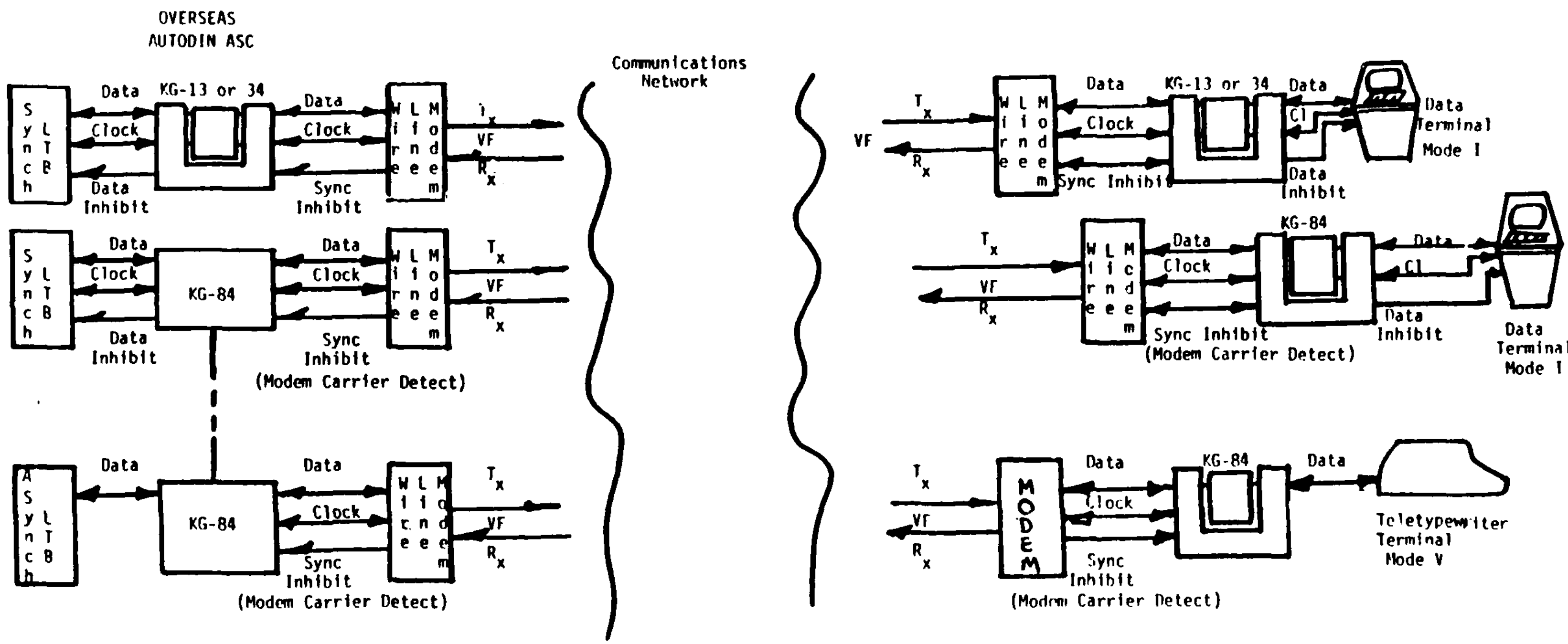


Figure 2
TYPICAL OVERSEAS AUTODIN DATA CIRCUIT
CONFIGURATION

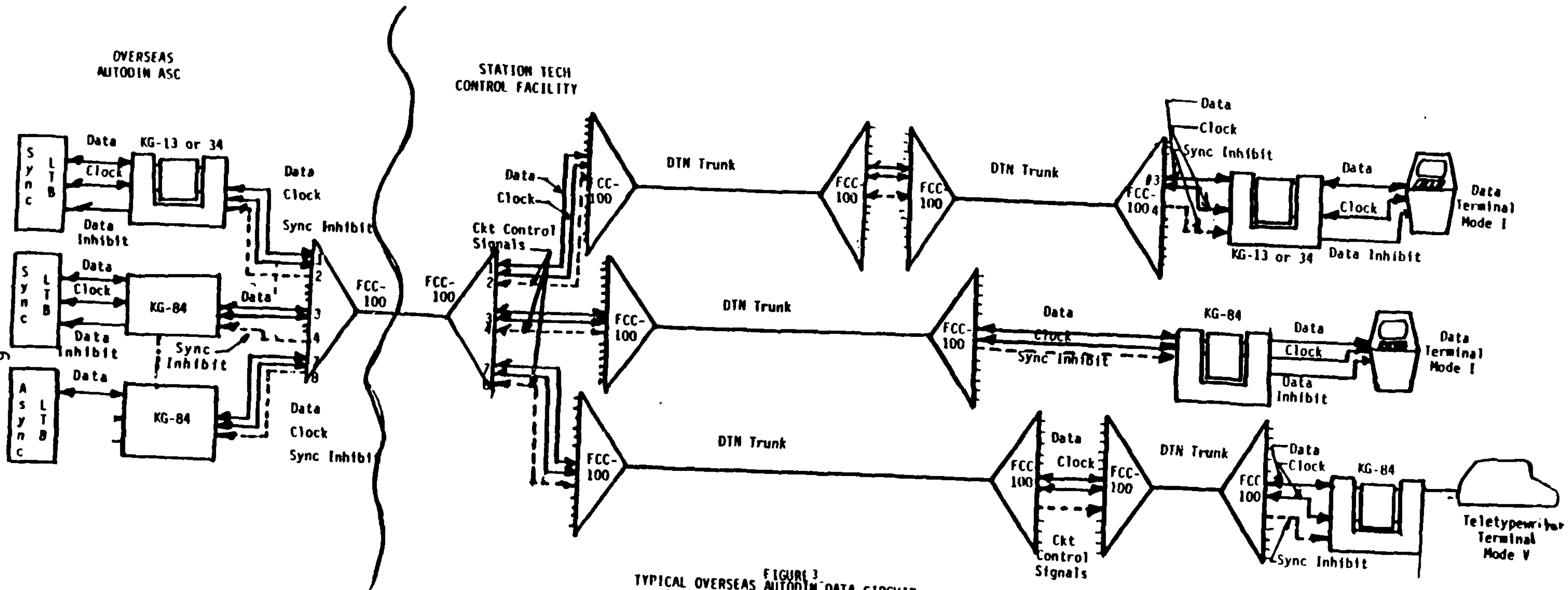


FIGURE 3
TYPICAL OVERSEAS AUTODIN DATA CIRCUIT
CONFIGURATION USING DTN TRUNKS

IV. APPLICATION TO MONITORING AND CONTROL SIGNALS

In the area of terminal-to-terminal interface as defined in RS-232-C, most wire-line modems provide for all of the RS-232-C control functions and imbed them in the VF data streams as shown in Figure 4A. However, with the implementation of the digital transmission systems within the DCS, these wire-line modems will be replaced with FCC-100's as the basic DCE. The FCC-100 does not currently provide for this RS-232-C control function on a per circuit basis and would require additional individual channels or ports to convey this control information throughout the DTN. As shown in Figure 4B, each of the control data leads (CTS, RTS, DTR) would require separate data ports, thus severely reducing the data transmission capability of the DTN. If a larger number of control leads available within RS-232-C were required, then one data circuit could utilize as much as 50% of the capability of the FCC-100.

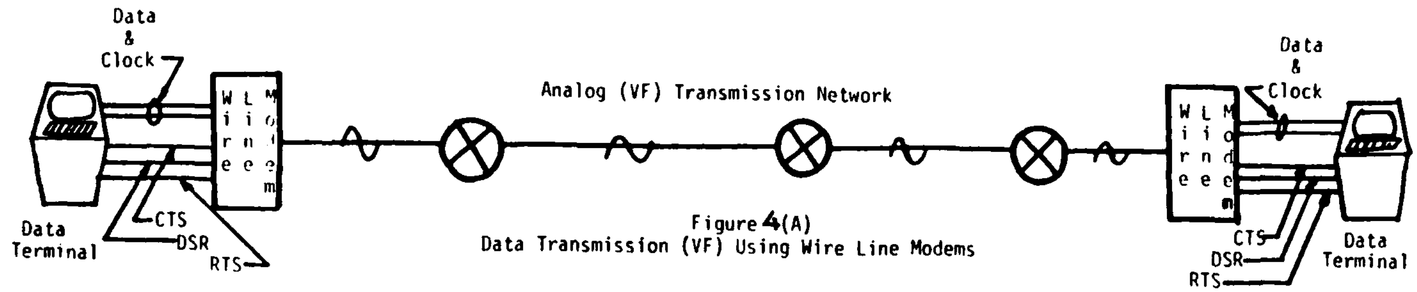


Figure 4(A)
Data Transmission (VF) Using Wire Line Modems

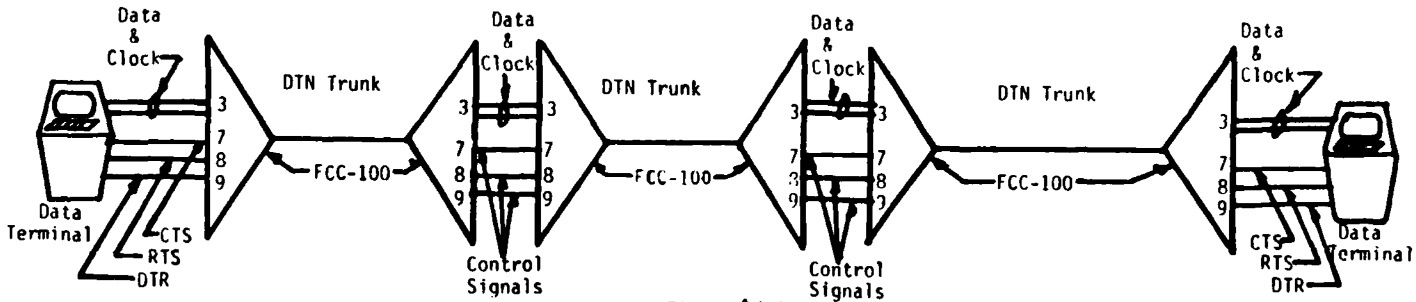


Figure 4(B)
Data Transmission (Digital) Using AN/FCC-100's As Presently Designed

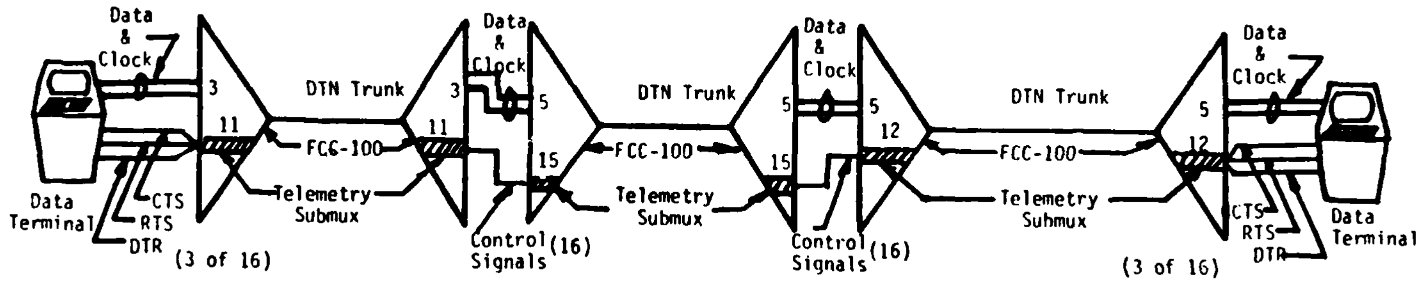


Figure 4(C)
Data Transmission (Digital) Using AN/FCC-100's Equipped with Telemetry Submux

Note: CTS-"Clear to Send"
DSR-"Data Set Ready"
DTR-"Data Terminal Ready"
RTS-"Request to Send"

V. TELEMETRY SUBMULTIPLEXER MODULE

1. DESCRIPTION

The telemetry submultiplexer module will provide a solution for the requirements described in the preceding sections. The telemetry submultiplexer module is designed to provide two independent ports, each capable of supporting eight duplex control signal leads conveying alarm information at a wide range of selectable data rates while replacing only two data ports within the FCC-100.

This enhancement enables remote sensing of various types of signals and alarms without the need for external, separate control lines, or dedicating serial ports for this purpose. As shown in Figure 5, one FCC-100 implemented with the telemetry submultiplexer module would accommodate up to fourteen data channels and their associated control signals. The attributes of this feature would be extended throughout the DTN providing end-to-end circuit status information (outage detection). For example, as shown in Figure 5, should one of the intermediate trunks fail, loss of circuit information (e.g., synchronization inhibit) would be transmitted in both directions (to the switch as well as the associated terminal). Thus, no manual intervention is required for cryptographic resynchronization involving circuit outages, and the efficiency of the FCC-100 would be minimally impacted.

2. UTILIZATION OF THE TELEMETRY SUBMULTIPLEXER MODULE

With the advent of the telemetry submultiplexer module, provision can be made to accommodate these control signals where commercial terminals are used within the DCS, as shown in Figure 4C. Again, these control functions can be provided without significant reduction in data transmission efficiency.

In addition to the above mentioned applications that satisfy operational user requirements, another characteristic of the telemetry submultiplexer module is that of providing circuit/equipment status and alarm information from local or remote facilities to a central DCS TCF. This capability will allow centralized monitoring and control of a number of AN/FCC-100's. For example, twelve FCC-100's at a location, each having six status/alarm indications,* could be monitored remotely using another FCC-100 with six telemetry submultiplexer port modules (each module configured to accommodate six status/alarm indications dedicated for two of the twelve FCC-100's). These seventy-two status/alarm indications could then be transmitted to the remote TCF for monitoring as shown in Figure 6.

---

*The AN/FCC-100 provides six alarm outputs. The six alarm outputs are: Remote Aggregate Loopback, Fault, Local Aggregate Loopback, Port Loopback, Power On, and Loss of Frame.

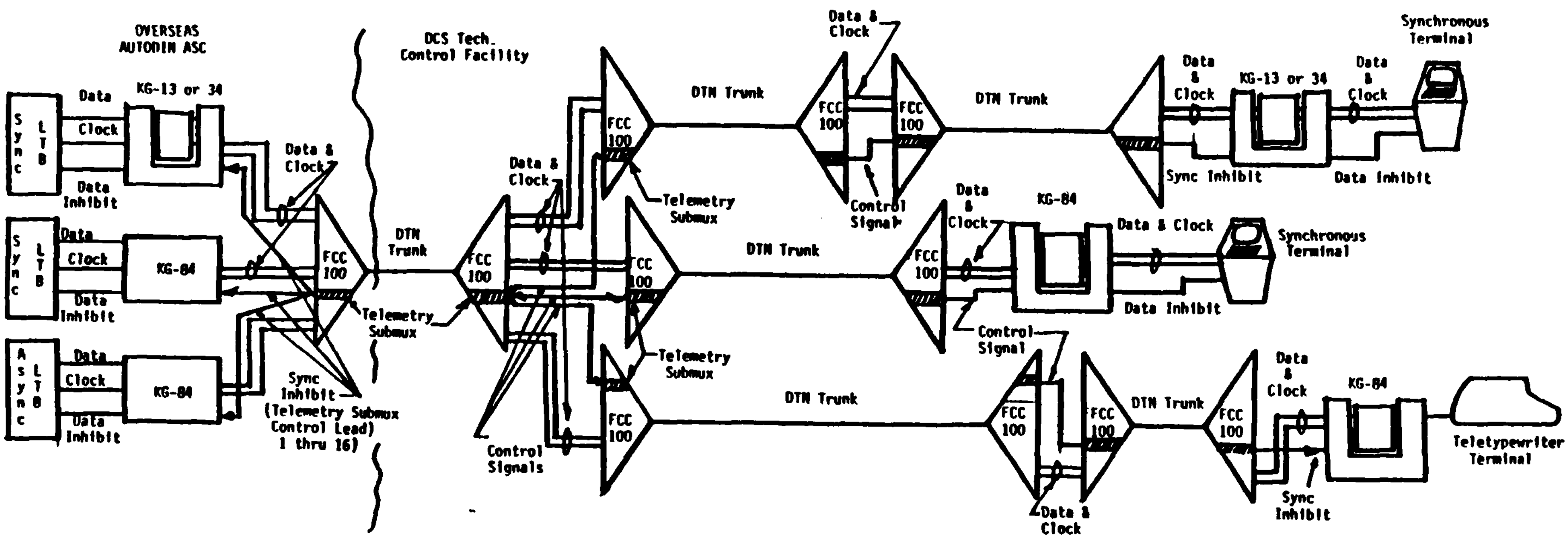


FIGURE 5
TYPICAL OVERSEAS AUTODIN DATA CIRCUITS OVER DTN TRUNKS EQUIPPED WITH THE TELEMETRY SUBMUX

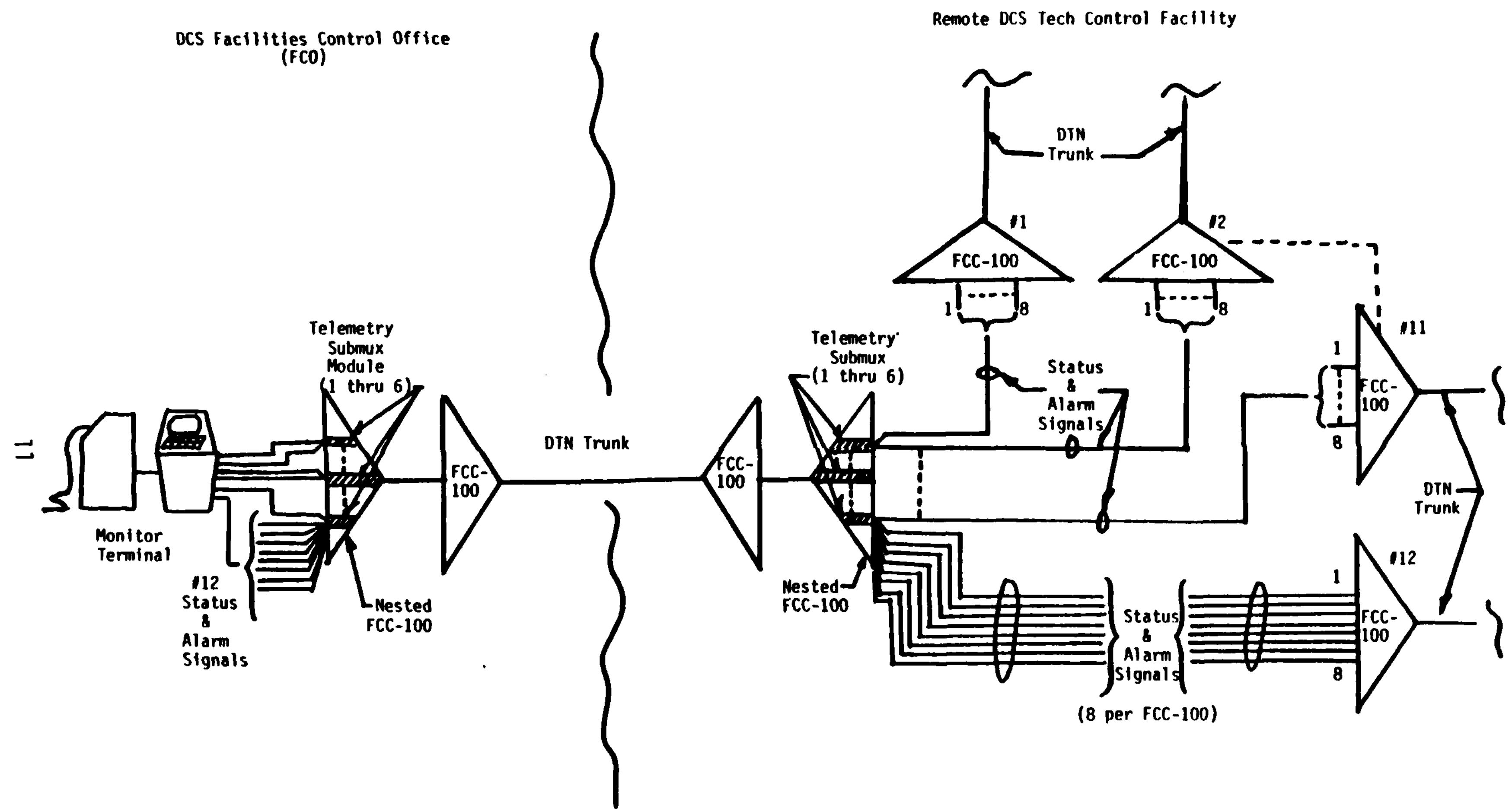


FIGURE 6
Data Transmission Network Remote Monitoring Capability

VI MONITORING AND CONTROL

1. DESCRIPTION

The AN/FCC-100 monitoring and control system will provide the technical control operator a means for remote and local monitoring and controlling each of the facilities' AN/FCC-100's. The software-controlled operation will provide a sequence of menus that allows the system operator to examine the status or change the configuration of each of the AN/FCC-100's. This micro processor-based system is expected to provide one parallel port for a printer, a serial port for interface with communications equipment, and a second serial port to allow interface with another level of hierarchial control.

2. UTILIZATION OF THE MONITORING AND CONTROL FEATURE

Using this monitoring and control system, the system operator will be able to monitor the status of the alarms from each AN/FCC-100, whether it is located locally or remotely. The operator can check the operational configuration of each AN/FCC-100 by a simple query. And by using the built-in downline load features, the operator can change the current configuration of the AN/FCC-100 to adapt to the changing communications environment. This feature is only limited by the hardware installed in the FCC-100. For example, if an AN/FCC-100 were fully loaded (16 channels) operating at an aggregate rate of 256 kb/s and suddenly was required to operate at 64 kb/s the operator could (from his control terminal) delete the lower priority channels and reduce the output rate to conform with the communications constraints. Likewise, from the control terminal, the operator can bring up new channels, switch traffic to spare channels, clear certain alarm conditions, and even maintain maintenance records using a companion printer.

VII. CONCLUSIONS/RECOMMENDATIONS

AN/FCC-100's are presently being installed at DCS facilities worldwide as the DTN becomes operational. Some DCS stations will contain large numbers of AN/FCC-100's, making the monitoring and control functions, which are manual at the present time, unwieldy and inefficient. The result will be a reduction in the capability of the system to survive and/or be restored. The MilDeps have already indicated that if DCA does not take the lead in developing a system as described above, they may install their own, thus leading to a melange of equipment at various locations and inconsistent procedures/doctrines for implementing these systems. The capability to restore and reconfigure the DCS after damage or attack is critical to providing a survivable, reconstitutable, communications system. A three phase program has been proposed for the monitoring and control of the DTN. These phases are:

Phase 1 Implement a standard station level monitor and control system using an intelligent terminal/microprocessor for monitoring the status (including circuit status information) of all AN/FCC-100's located within a DCS station as well as any other DTN associated equipment, performing AN/FCC-100 reconfigurations (both in-station and remote), and providing records of status, outages, and actions taken.

Phase 2 Extend AN/FCC-100 critical DTN alarms to a central control (master) at a DTN Facilities Control Office.

Phase 3 Provide automated DTN network monitoring and control to include electronic patching of trunks and circuits and reconfiguration of AN/FCC-100's from local and regional control facilities.

This proposal was presented to the DTN Engineering Sub-Working Group by DCEC in February 1983, and the Group agreed to support this program in principle.

A unsolicited proposal was received in February 1984, from Data Products of New England to modify the AN/FCC-100 to accept automatic polling. This proposal essentially satisfies phase 1 of the three phase program for the monitoring and control of the DTN. DCEC has reviewed the unsolicited proposal and recommends that this capability be developed.

Currently efforts are underway that should culminate in the development of prototype equipment which would essentially satisfy Phase I of the three phase program. The equipment will then be tested in an operational environment (tentatively at NAVCAMSLANT, Norfolk, Virginia). Based on these operational test results, a decision will be made as to the applicability of this equipment to the DCS.[1]

---

[1]The U.S. Army awarded a contract to Data Products of New England on 23 Sep 85. This prototype equipment is scheduled to be delivered in June 1986.

REFERENCES

[1] DCEC TR8-81. "System Design Plan for a DCS Data Transmission Network," July 1981.

[2] MIL-STD-188-114, "Electrical Characteristics of Digital Interface Circuits," March, 1976.

[3] EIA RS-232-C, Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange, June, 1981.

[4] CCITT Volume VIII Rec. V.24, Data Communication Over the Telephone Network, November, 1980.

DISTRIBUTION LIST

R100/R101	- 1		R600	- 1	
R110	- 1		R800	- 1	
R120	- 1		NCS-TS	- 1	
R130	- 1		B100	- 1	
R141	- 14		308C	- 1	
R200	- 1		308	- 1	
R400	- 1		J700	- 1	

DCA-EUR	- 2	Defense Communications Agency European Area ATTN: Technical Library APO New York 09131
DCA-PAC	- 3	Commander Defense Communications Agency Pacific Area Wheeler AFB, HI 96854
DCA SW PAC	- 1	Commander, DCA - Southwest Pacific Region APO San Francisco 96274
DCA NW PAC	- 1	Commander, DCA - Northwest Pacific Region APO San Francisco 96328
DCA KOREA	- 1	Chief, DCA - Korea Field Office APO San Francisco 96301
DCA-Okinawa	- 1	Chief, DCA - Okinawa Field Office FPO Seattle 98773
DCA-Guam	- 1	Chief, DCA - Guam Field Office Box 141 NAVCAMS WESTPAC FPO San Francisco 96630
US NAV SHORE EE PAC	- 1	U.S. Naval Shore Electronics Engineering Activity Pacific, Box 130, ATTN: Code 420 Pearl Harbor, HI 96860
US NAVALEX Portsmouth	- 1	U.S. Naval Electronics Engineering Center ATTN: Technical Library P.O. Box 55, Portsmouth, VA 23705
USDCFO	- 1	Chief, USDCFO/US NATO APO New York 09667

END
FILMED
4-86
DTIC